

PAGAN newsletter 1986

Conservation of Pagan monuments

The monuments of Pagan are threatened by several agents, the most perennial one being the relentless climatic aggression, and the most deadly, though only occasional, one being the earthquakes.

Fortunately, Pagan lies in the central arid zone of Burma, where relative humidity and mean annual rainfall, with 62 cm, are considerably lower than, for instance, in Rangoon, where the average rainfall reaches 247 cm annually.

Precipitation figures for Pagan are as follows:

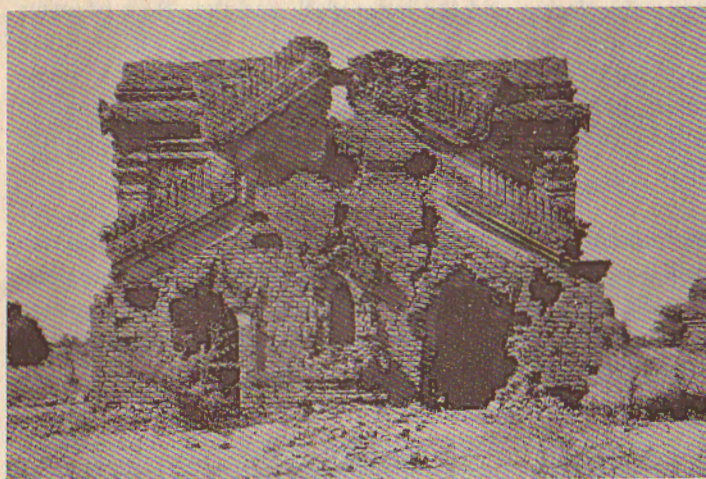
	J	F	M	A	M	J	J	A	S	O	N	D
rainfall :	-	-	3	15	83	88	47	85	134	115	40	11 (mm)
number of												
rainy days :	-	-	-	1	4	5	4	5	8	6	2	1 (days)

Rain has proved to be extremely dangerous to unattended or poorly maintained monuments in Pagan. As a continuous process, the combination of rain and high temperatures favours the fast growth of tropical vegetation on the roofs and walls, whose masonry is broken up by their deep roots. Such problems, admittedly common to all ancient monuments in the tropical zone, are greatly magnified in Pagan by the immense number of monuments and the size of the archaeological area.

The Pagan masonry consists of fine quality bricks, usually well baked and of rather large-size: $36 \times 18 \times 6$ cm, and in several cases up to $42 \times 21 \times 8$ cm, bound by a mortar which is merely clay. Though rather poor when dry, its capacity is generally quite sufficient to bear the weight of the structure, thanks to the generous thickness of walls. Problems arise when this clay mortar is watered, as it becomes slippery, begins to expand, and is progressively washed out by rainwater.

The brickwork is usually very fine on the facing of walls, with remarkably thin joints, obtained through the clever use of the concavity of the lower surface of each brick. It is rougher on the inner part of walls where joints are easily 2 or 3 cm thick, and bricks used may be of different sizes and may include broken pieces and debris.

In addition, the facing brickwork is built without headers, and its liaison with the core is usually poor or even non-existent. The greatest monuments, built under direct royal patronage, are exceptions in this respect, as the facing has been strongly attached to the inner part of walls by regularly spaced stone headers, and this probably explains their better present condition. It also proves that the Pagan builders were aware of the problem.



East face
December 1985



North view
August 1986

Monastery n° 525 near Minnanthu village, is a small rectangular structure (6.68×4.62 m outside) of the type most common in Pagan, with a central vaulted room and four doors, two on the main and eastern side and one on both the north and south sides, located near the east corners. At the north-east corner of the building, the base of the wall has been eroded for many years, and this whole corner collapsed on 10 August 1986 after two days of rain.

Pagan walls were originally protected by plastering with a strong stucco made of lime mortar strengthened by organic additives. Temples and stupas then were white and dampproof, as a few monuments still are, those which have kept their religious function through the ages and are regularly maintained and whitewashed by their monks and trustees. But the great majority of the monuments are now reddish buildings, with their brickwork exposed by the fall of stucco. Cracks, caused by age and earthquakes, allow rainwater to penetrate into their masonry, dampening and washing out the clay mortar.

Roofs and terraces are the weakest points. In a very few days after the 1975 earthquake, as many monuments as possible were protected, at least temporarily, to prevent water penetration into their upper part: emergency filling of cracks, repairs of roofs, clearing of debris, and in some cases the protection of a badly damaged roof above mural paintings, has to be done with by temporary tarpaulin covering. This timely action certainly saved many monuments from further decay or total collapse, but it was of course impossible to implement it on the more than 2,000 structures that exist in Pagan, and, during the following years, each period of heavy rain imposed its toll on these unattended monuments. It is all too clear that any monument which cannot be regularly maintained and properly repaired is slowly disintegrating, through a relentless decaying process which becomes dramatically apparent during the rainy seasons: 13 monuments were damaged, including cases of total or partial collapse, in

October 1983 when 18 cm of rainfall was recorded in only three days; then again in August 1986, after two days of rain, the corner of monastery n° 525 collapsed, exposing the inner core of walls and vaults and opening the way for its total destruction in the near future. All over Pagan, numerous brick mounds mark the location of former structures which have been totally erased by the same process.

Maintenance and waterproofing of roofs and superstructures are an absolute necessity to prevent the total ruin of monuments, but even this is not enough. Damage to the facing of walls and to the bases can be noticed on many monuments; this indicates the lack of connection between this facing and the inner wall, and the effect of water percolating into the wall, whose facing and inner core have different moisture gradients. The progressive disintegration of the base, which may be total on those structures whose elementary stability becomes affected, is due to the impregnation of the lower part of walls by rainwater and to the pressure from the clay mortar expanding under humidity.

The replastering of all monuments with new stucco is not realistic, given the number of them, and besides it will be difficult to accept this solution from an aesthetic point of view: the great brick walls of Pagan have now become a specific feature of the landscape, and a beautiful one. The archaeological authenticity of the monuments is now reflected in the exposed brickwork, and must be protected as it is.



East face, 1975



Same view, 1983

After three days of heavy rainfall in October 1983, the vault of the central shrine of temple n° 1966, on the east side of Pagan village, caved in completely and its superstructures collapsed. This damage was the result of rainwater percolating into the unattended upper parts of the building, thus weakening and disintegrating the mortar in the brick vault.



Stupa n° 428, December 1984, from south-west. The terraces which formed the base of the dome have been totally eroded by percolating rainwater. In this condition, the stupa withstood the 1975 earthquake, oscillating like a pendulum without structural disintegration.



Stupa n° 581 north of Minnanthu, August 1986. Previously in the same condition as n° 428, its base is being reconstructed all around the monument. The same process was applied to n° 428 in 1985.

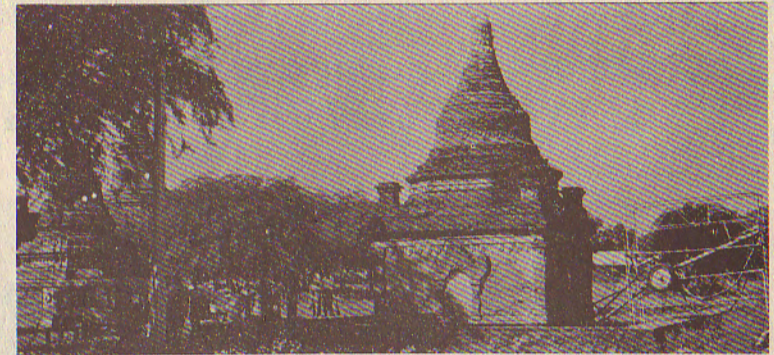
Deep pointing of joints is a more acceptable solution, and has already been implemented on numerous monuments. It must however be improved in quality, using the right kind of mortar with a greater concern for the final appearance of the pointed masonry in terms of texture and colour. A certain amount of adulteration of the original fabric is unavoidable, since the joints were never pointed before plastering of walls, but experiments have to be made to mitigate this adulteration. Still, pointing of joints seems to be the most suitable compromise between the preservation of archaeological authenticity and the requirements of structural conservation.

In August 1986, J-C. Yarmola, a French architect, joined the Pagan project as a Unesco consultant for masonry conservation and strengthening. These questions of maintenance, proper pointing and waterproofing were thoroughly discussed with the local teams from the Construction Corporation and the Department of Archaeology, as well as with their headquarter staff in Rangoon, and various field tests were carried out in Pagan in the interest of better masonry repairs, selection of mortars, clays and bricks.

At the same time, specific equipment was provided to Pagan by the project for the actual implementation of strengthening methods recommended by the IZIIS team after their 1982 study of monuments (see *Pagan Newsletter* 1983). This equipment had first to be put in working order (which was not always as simple as it should have been, given the cursory nature of some manufacturers' notices . . .), then injection tests were carried out on a monument, using grouts of various compositions and proportions (lime, cement, brick powder, etc.). Before injecting, pointing of joints was completed to prevent leakage of grout through open joints and minor cracks.

The main difficulty came, once again, from the nature of the mortar: being clay, it is naturally waterproof and expands under humidity, thus preventing a deep penetration of grout. Other mixtures will be tried, with additives such as bentonite, for better penetration. Injection of chemical grouts, mainly silicates, will also be tested for improvement of the bearing and shearing capacities of mortar. However, there is little hope of significantly improving the mortar strength, and injections will be more systematically used around the inserted steel ties, to bind them to the masonries and to protect them from corrosion. These ties will eventually be the major method of helping the buildings to keep their structural integrity when subjected to disruptive seismic forces. They will be inserted in long bores drilled into the masonry at the most critical levels in order to form complete belts around the building. On a smaller scale, steel pins will be set into the masonries and sealed by injections in order to ensure the joining of the facing and core of brick walls.

Another technical mission is planned in Pagan for January 1987, when J-C. Yarmola, P. Gavrilovik (Iziis) and P. Pichard carry out further experiments and assist the Burmese engineers to select and implement the most suitable reinforcement techniques.



Temple no 1617, a late structure in the precincts of the Pagan Museum, has been selected for injection tests.



After the brick masonry has been pointed, injection packers are fixed in the drilled long bores.



Various types of grouts are injected into the masonries.

Presentation of a monument :
THE SEINNYET NYIMA STUPA N° 1086 (458)



Seinnyet Nyima stupa 1086 and Seinnyet Ama temple 1085, from the north.

Not far from the river bank and 3 km south of Pagan, along the road to Thiripyitsaya, stand the two Seinnyet monuments: Seinnyet Ama temple 1085 and Seinnyet Nyima stupa 1086, both enclosed by one boundary wall and by an inner and lower wall around the central brick paved courtyard. The only entrance to the complex is on the west side, although the main access to the Seinnyet Ama temple is on its east side, where an entrance hall faces the stupa. The first close contact with the monuments is thus from behind.

The Seinnyet Nyima stupa, on the eastern part of the courtyard, has three square terraces, with corners marked by small stupas of different shapes, and a fourth terrace, 16-sided. There is no stairway to give access to these terraces. Above, the bell shaped dome is topped by a moulded brick masonry block and a high conical spire. Such an upper block is the distinctive feature of numerous stupas which in Pagan are called "Singhalese type stupas". On its simplest form, for instance on Sittana stupa 987, it is in fact somewhat similar to the *hataras-kotuva* found on top of stupas in Sri Lanka, or to the *harmika* built on Indian and Nepalese stupas. On Seinnyet Nyima however, as on many other Pagan stupas, the shape is quite different and purely Burmese, with a strong cantilevered profile and a multi-recessed plan. This masonry block is often called the "relic chamber", not very accurately as the relics are generally concealed at the base of, or under, the dome. A special feature of Seinnyet Nyima is the niche, shaped like a typical Pagan temple with its porch and its square tower, sheltering a fine Buddha image on each of the four cardinal directions. There is no stone inscription to date these two monuments, whose style strongly suggests the second half of the 12th century AD. A former stupa, now encased in the masonry of the bellshaped dome, can be seen through a tunnel dug some time ago at the base of this dome.



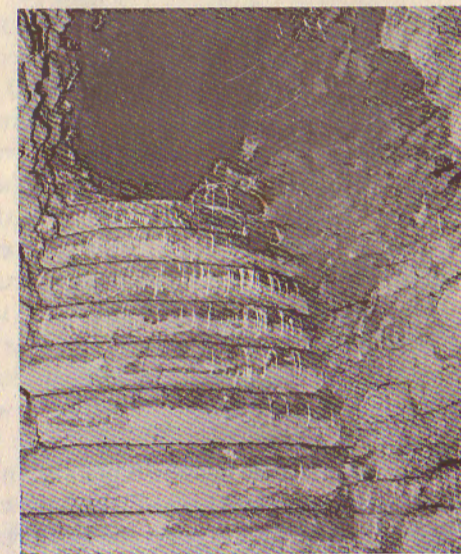
Upper parts of the stupa damaged by the 1975 earthquake.



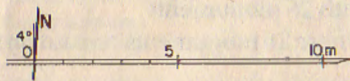
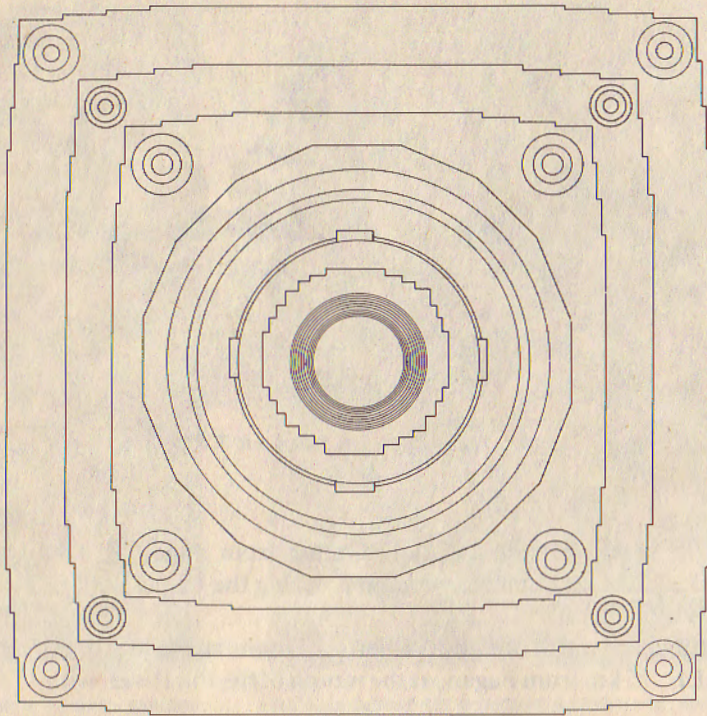
Same view, from the west: the spire was restored in 1977.



The western niche, half way up the bellshaped dome.

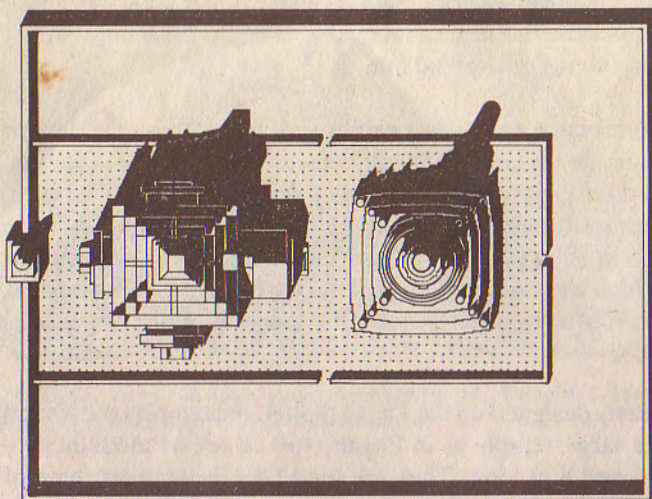


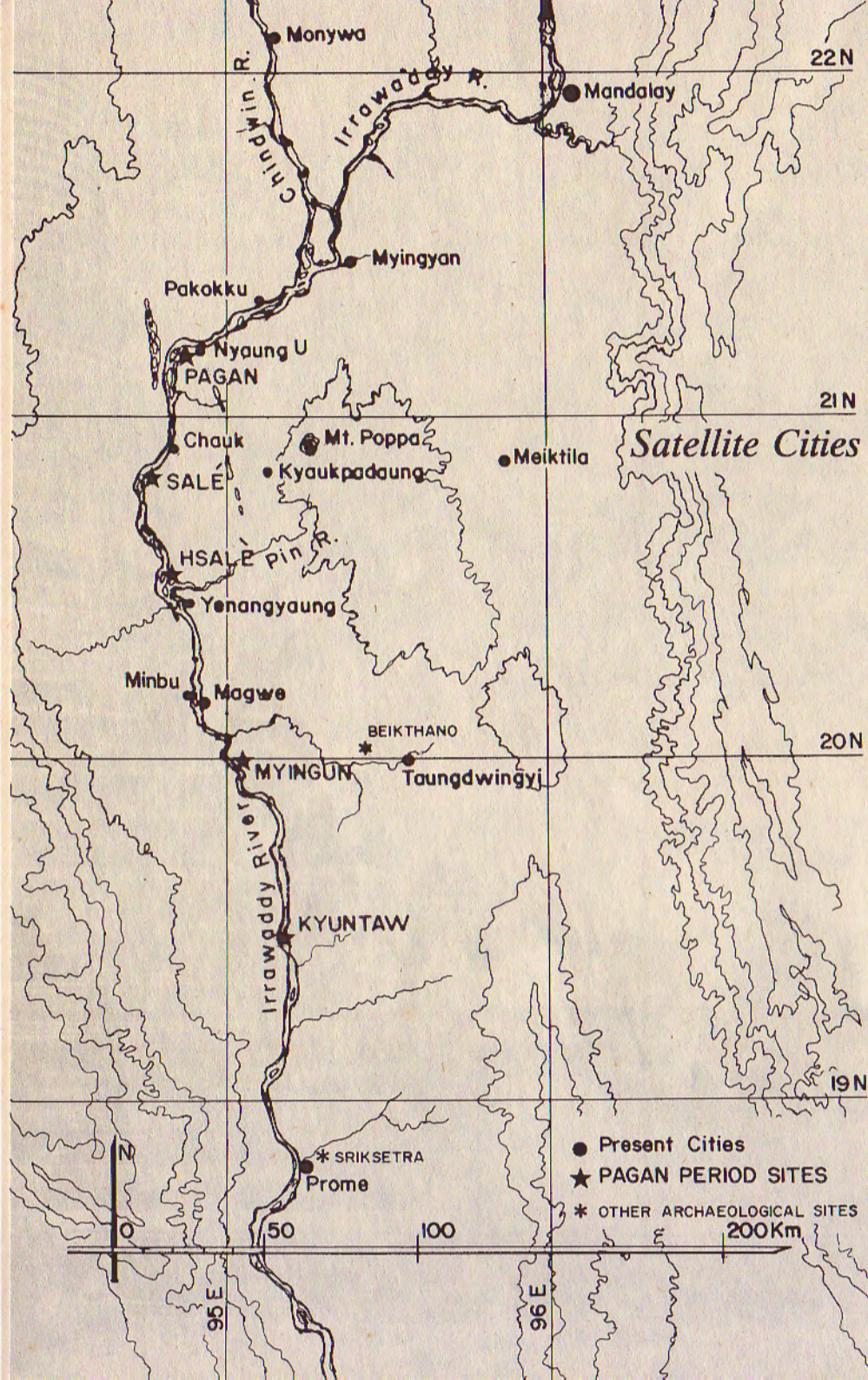
The top of the former stupa, now encased in the masonry of the 12th century dome.



Seinnyet Nyima 1086: plan.

Seinnyet Ama 1085 and Seinnyet Nyima 1086: site plan.





Hsalè: from right to left, temples n° 7, 8, 9, 10 and 13, 14, 15; from the east.

Along the Irrawaddy River and downstream from Pagan, are four sites where numerous Buddhist monuments were built during the Pagan period. They are from north to south:

- SALE, 46 km south of Pagan, where 103 monuments are identified.
- HSALE, 75 km from Pagan, at the mouth of the Pin River, with 41 monuments listed.
- MYINGUN, 195 km from Pagan, with 26 monuments.
- KYUNTAW, 240 km from Pagan, where 26 monuments remain on an island in the Irrawaddy River.

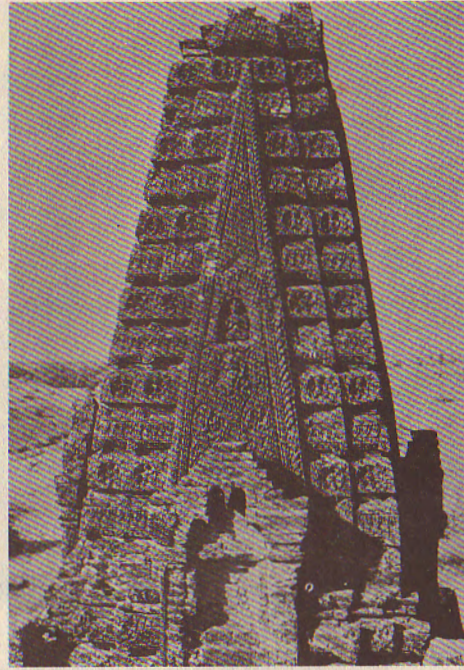
By the same stroke of fate, these sites where the concentration of monuments is a clear sign of their activity under the Pagan dynasty, are now no more than villages, just like Pagan itself, and their monuments are surrounded by rural landscape. Only Salé, where chemical industries have recently been located, has developed into a small town, but the modern urbanized area is still far smaller than the area on which ancient monuments are spread out.

These monuments seem to date exclusively from the second half of the 13th century AD, which is the end of the Pagan period. They show less variety of type, size and shape than do the monuments of Pagan: most of them are temples, along with a few stupas or monasteries. Out of the 41 monuments listed in Hsalè, 27 are temples (including 5 in ruins), 4 are stupas, 3 are ruined monasteries and 7 are now brick mounds, which were probably temples, possibly stupas. In addition, around 20 other brick mounds of various sizes mark the location of ancient monuments but are not listed as such.

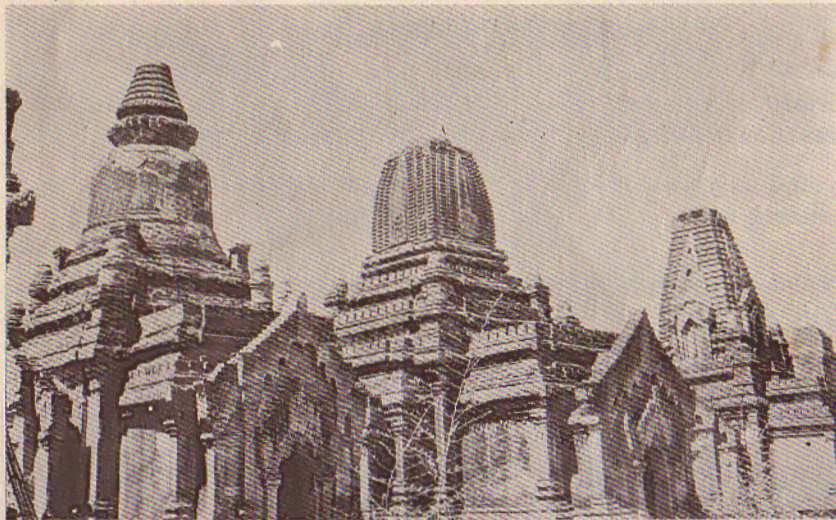
Though clearly designed on the Pagan model, the temples show special characteristics. There is no large temple as in Pagan, and all are of medium or small size, usually between 16 and 8 m long. They are based on the simplest type of Pagan temple: a square brick building with a vaulted central shrine, accessible only on one side



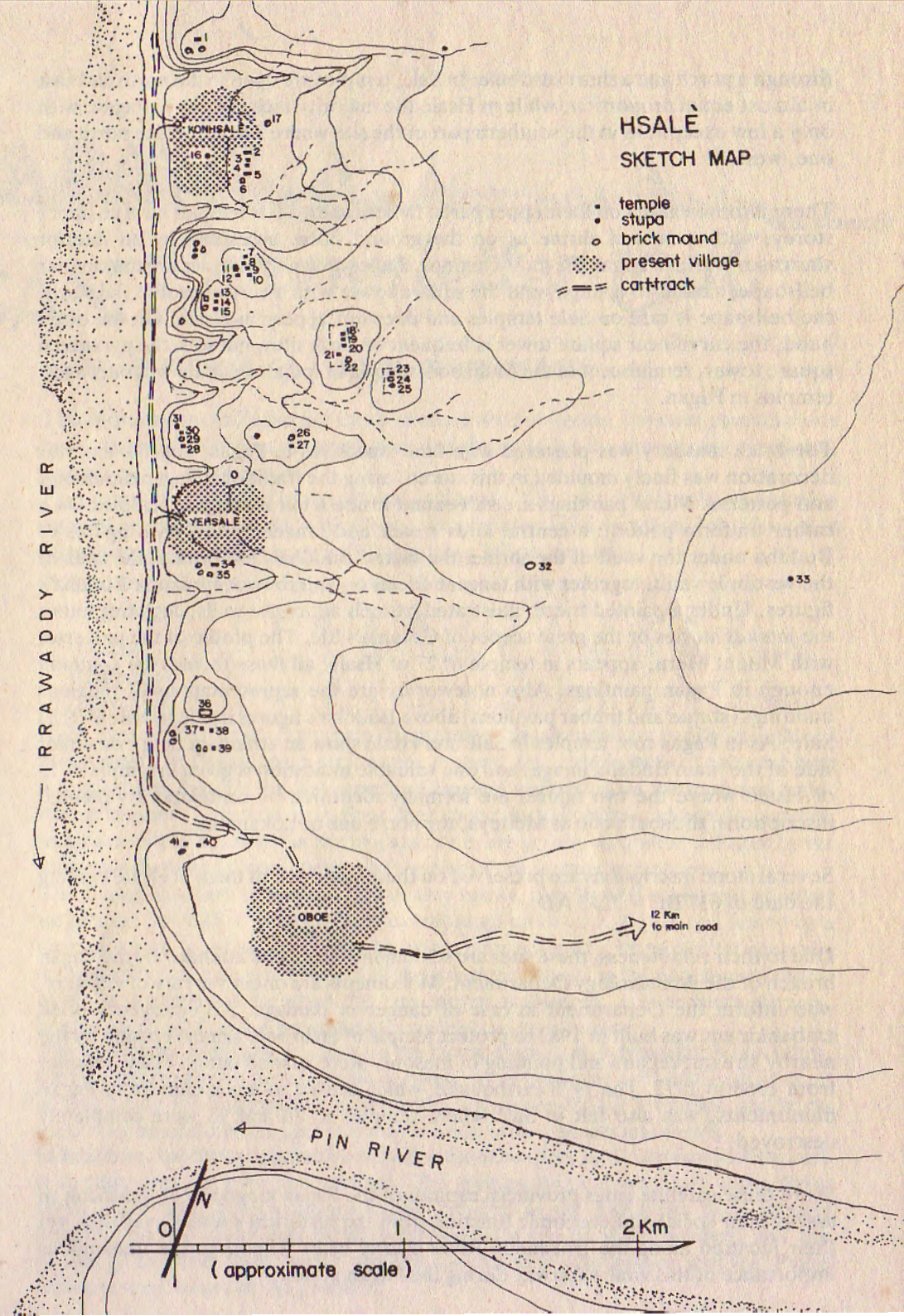
Hsalè, temple n° 8, mural painting inside the central shrine, on the right of the Buddha image.



Hsalè, temple n° 18, pyramidal square tower, south face.



Salé, temples n° 74, 73, 72. Variety of upper parts: bellshaped dome (stupa-like), curved square tower (*sikhara*), pyramidal square tower (Mahabodi style).



through a porch and a short vestibule. In Salé, temples are open to the north and east in almost equal proportion, while in Hsalè the majority face east, as in Pagan, with only a few exceptions in the southern part of the site where 3 temples face north and one, west.

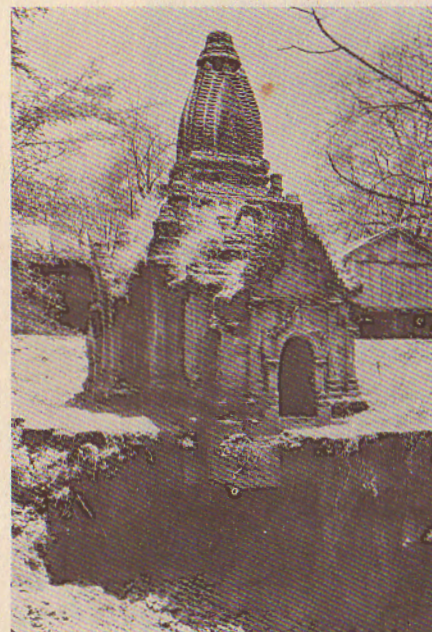
There is more variety on their upper parts. In both sites, a few temples have an upper storey, with a central shrine as on the ground floor, accessible by an interior staircase. While in Pagan the most common shapes crowning temples are the circular bellshape, similar to a stupa, and the square tower with a curved profile (*sikhara*), the bellshape is rare on Salé temples and does not appear in Hsalè. On the other hand, the curvilinear square tower is frequent on both sites, but so is the pyramidal square tower, reminiscent of the Mahabodi temple in India, which crowns only a few temples in Pagan.

The brick masonry was plastered with lime stucco, as in Pagan, and the exterior decoration was finely moulded in this stucco, using the traditional Pagan mouldings and patterns. Mural paintings are still extant inside a fair number of temples, on a rather uniform pattern: a central lotus rosace and tangent circles with figures of Buddha under the vault of the shrine, the sacred Buddha's footprint at the apex of the vestibule vault, together with tangent circles or with rows of miniature Buddha's figures. Under a painted frieze, illustrated pannels adorn the walls, depicting either the *jatakas* stories or the great scenes of Gotama's life. The profile of the universe, with Mount Meru, appears in temple n° 27 of Hsalè: all these themes are common enough in Pagan paintings. Also noteworthy are the representations of religious buildings (stupas and timber pavilions) above Buddha's figures inside temple n° 92 of Salé. As in Pagan too, temples in Salé and Hsalè show an attendant figure on either side of the main Buddha image, and one valuable indication is given in temple n° 13 of Hsalè where the two figures are formally identified by contemporary painted inscriptions, the south one as Metteya, the north one as Lokanatha.

Several stone inscriptions are preserved on these sites, one of them in Hsalè bearing the date of 637 BE = 1275 AD.

Due to their remoteness, these sites are seldom inspected and attended by the Pagan branch of the Archaeology Department. Monuments are under the care of villagers, who inform the Department in case of danger or damage. An emergency brick embankment was built in 1982 to protect temple n° 86 in Salé against erosion by the nearby stream; repairs and pointing of masonry were carried out on Hsalè temples from 1968 to 1972. The 1975 earthquake, which caused so much damage to Pagan monuments, was also felt in Salé where temples n° 76 and 93 were completely destroyed.

Were these satellite cities provincial capitals of the Pagan kingdom? It is difficult to assess their social and economic function from the historical sources available, yet their location along the Irrawaddy River clearly bears witness to the tremendous importance of this vital waterway during the Pagan period.



Salé, temple n° 86 threatened by total destruction from erosion of the bank of the stream (1981), and the brick embankment built to protect it in 1982.

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Kindly send us names of interested persons and institutions for inclusion
in our mailing list.

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